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Western Development Laboratories
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QUARTERLY STATUS REPORT - Report Period of 1 August to 1 November 1966

RELIABILITY STUDY ON ZENER DIODES USED IN THE SATURN PROGRAM

CONTRACT NO. NAS 8-20315

Quarterly technical report No. 1 on the status of the Zener Diode Reliability Study in accordance with WDL-TP 2114 and NASA Procurement Request DCN 1-6-60-00029.

This quarterly report covers in detail the current status of Tasks 1, 2, and 3. These tasks are described in the WDL Test Proposal 2114 are respectively: 1) Information Study and Survey; 2) Parts Procurement and 3) Step Stress Matrix Evaluation. The tasks are discussed below in their consecutive order.

Task 1 - Information Study and Survey

WDL engineering has reviewed the up to date listings and reports submitted through the Interservice Data Exchange Program (IDEP) for a basic indication of zener diode manufacturers and their respective failure modes. The results of this inquiry are summarized in Table I. This information coupled with information obtained from FARADA (Failure Rate Data) and WDL's accumulated data from various Air Force and NASA programs has allowed for the initial vendor selection of TRW Electronics, Motorola Semiconductor Inc. and Dickson Electronics Corp. It should be noted here that these vendors all hold current military qualification of the 400 m Watt zener diode series although this was not established as a definite requirement of this test program. A WDL specification was generated for the test sample procurement (WDL-SL-171723) of 3,000 ea. zener diodes comprised of the three manufacturers and three selected voltage ranges; JEDEC 1N746A (3.3V), 1N758A (10.0) and 1N980B (62.0V). The Purchase Order was let 8/3/66.

HC $1.00
MF .50

TABLE I

IDEP SUMMARY OF VARIOUS MANUFACTURERS VS.
QUANTITY OF FAILURES

MANUFACTURER	NO. TEST UNITS	NO. FAILURES TOTAL	PERCENTAGE FAILURES
Continental Device Corp. (CDC)	231	23	9.9%
Delta Semiconductors	60	16	26.7%
Dickson Electronics	100	2	2.0%
Motorola Semiconductors	175	10	5.7%
Texas Instruments Corp.	260	21	8.1%
Transitron Electronics Corp.	231	23	9.9%
TRW Electronics	159	8	5.0%

Task 2 - Parts Procurement

The zener diode procurement effort is continuing and of this date the following diodes have been received:

Manufacturer	Received	To be Received
Dickson	800 all types	133 ea. of 1N980B
Motorola	666 of 1N758A & 1N980B 155 of 1N746A	179 of 1N746A
TRW	666 of 1N746A & 1N758A	333 ea. of 1N980B

An approximate 45 day delay has been incurred because of slow delivery by all part vendors. The reason given by both TRW and Dickson was that of low yield of the high voltage zener diodes during manufacturing caused late shipments. Motorola has not submitted any reason for late shipment. In any case, the now scheduled date for the receipt of all test samples is 15 Nov. 1966.

Task 3 - Step Stress Matrix Evaluation.

As of this report, all test samples which have been received are now serialized using Brady high temperature labels. One diode from each manufacturer has been stripped of paint to verify and examine the manufacturer's construction of interior elements.

Work has been completed on all required test fixtures including the setting up of a measurement station which will allow for IBM 526 data print out of all basic measurement parameters. A computer program has been set up to present

all data in an easily presentable format. Attachments are included of the basic electrical measurement test methods and a copy of the proposed data analysis format. The computer return will provide between electrical measurements the absolute difference value and percent change of each parameter measured. In addition, each test group, such as the High Temperature Operation Group, will have computed at measurement the group mean χ and standard deviation σ. All devices which do not meet specified test limits will be tabulated separately.

Attachment A contains a copy of the Phase I. Step Stress Evaluation, part of this test program. Initial electrical measurements are now underway on $^{1}/f$ and multistate noise measurements. During the next quarterly report period, it is expected that the step stress matrix testing will be completed, data analysis completed, failure modes identified and the needed screening recommendations presented.

W. D. Boltz
Sr. Engineer

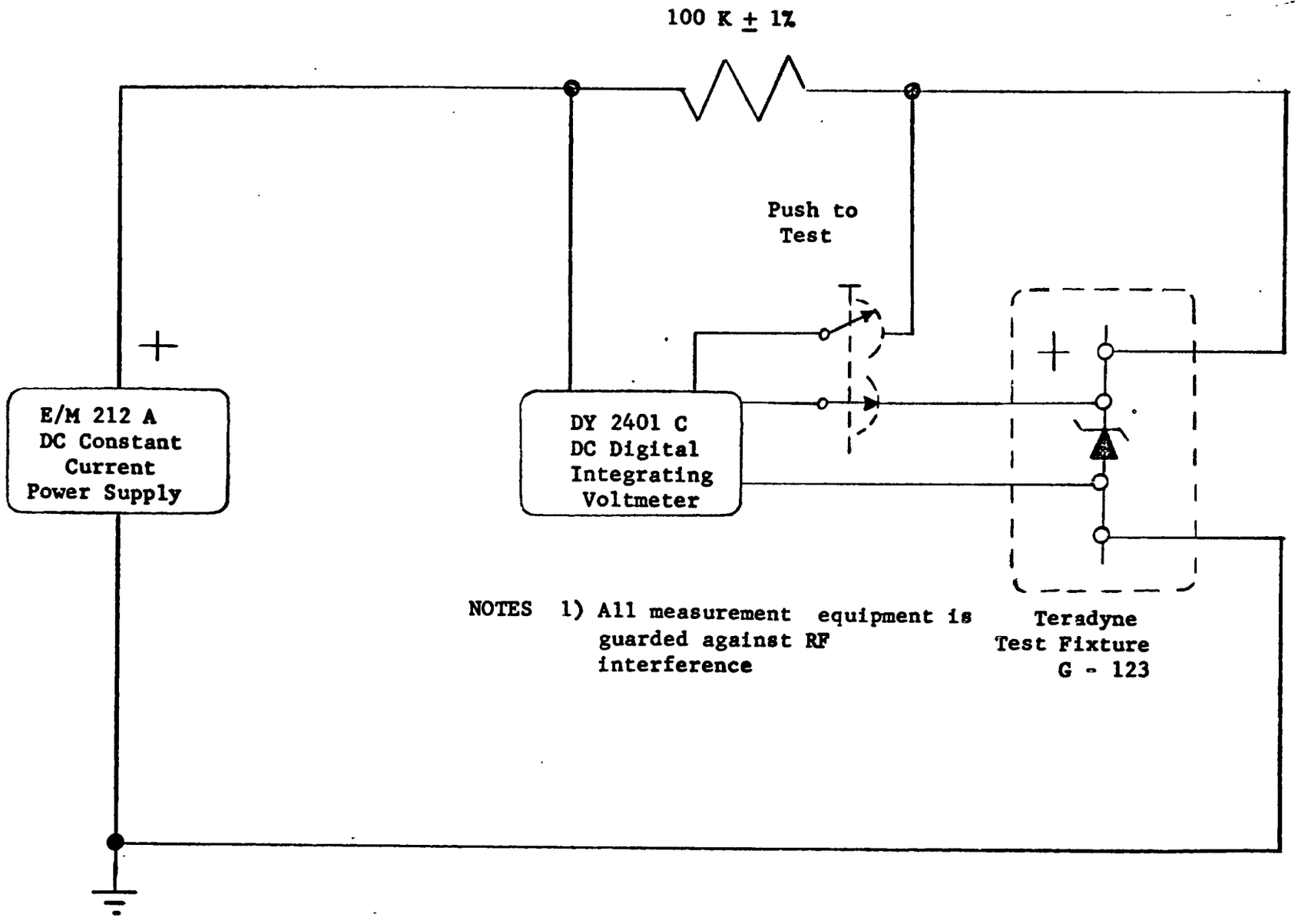
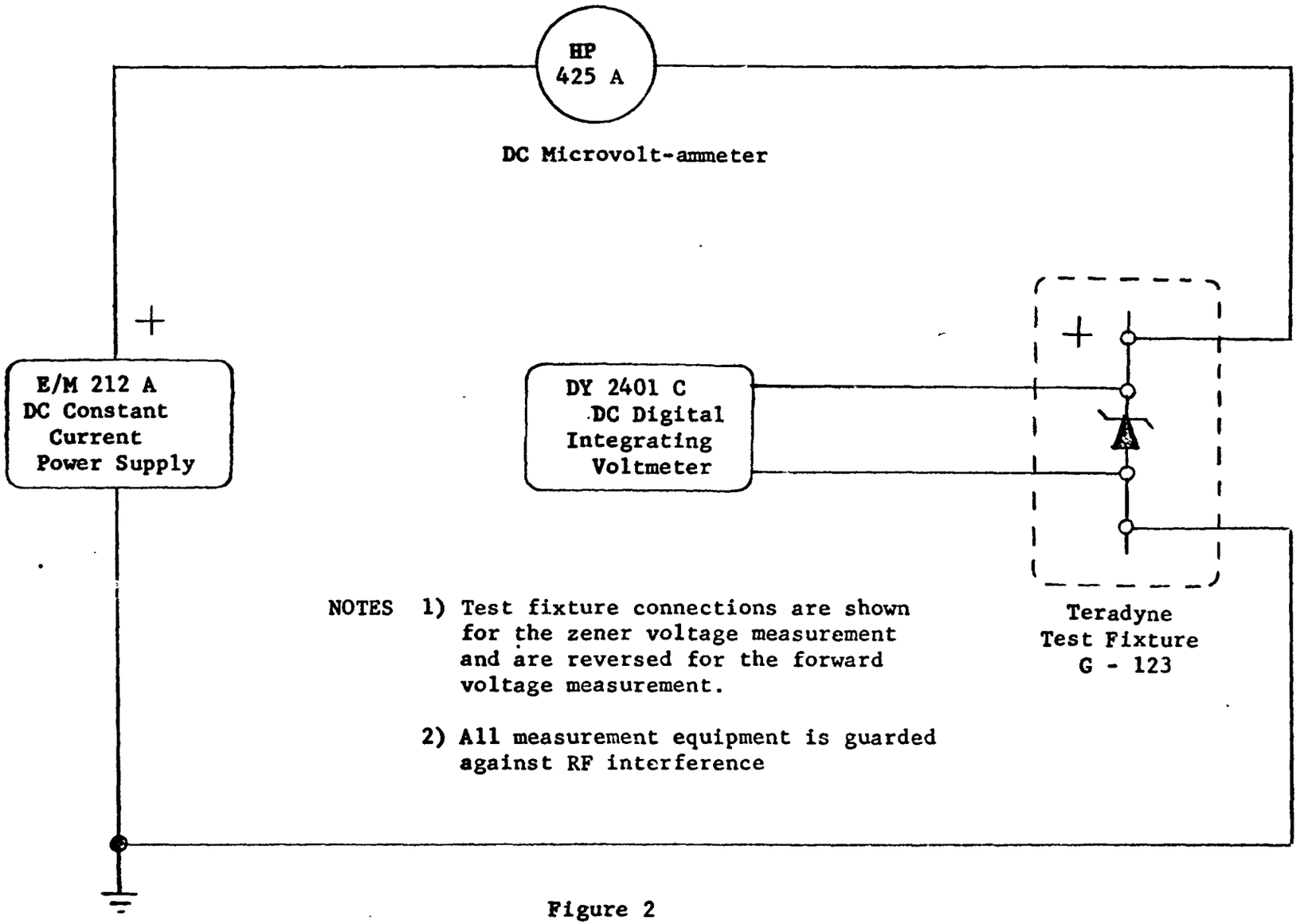


Figure 1

Basic Schematic of Leakage Current Measurement



NOTES 1) Test fixture connections are shown for the zener voltage measurement and are reversed for the forward voltage measurement.

2) All measurement equipment is guarded against RF interference

Figure 2

BASIC SCHEMATIC OF FORWARD VOLTAGE

AND ZENER VOLTAGE MEASUREMENT

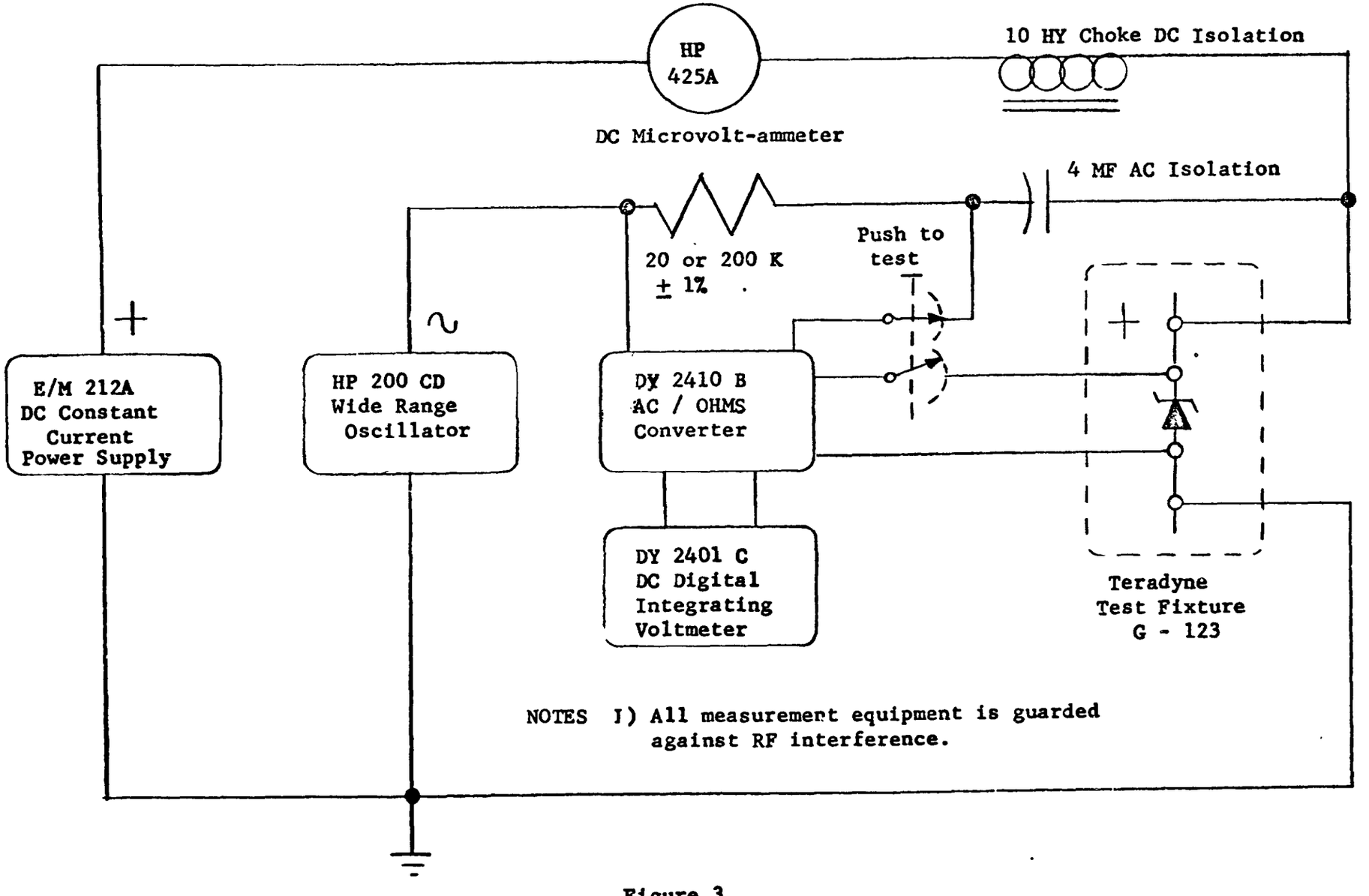


Figure 3

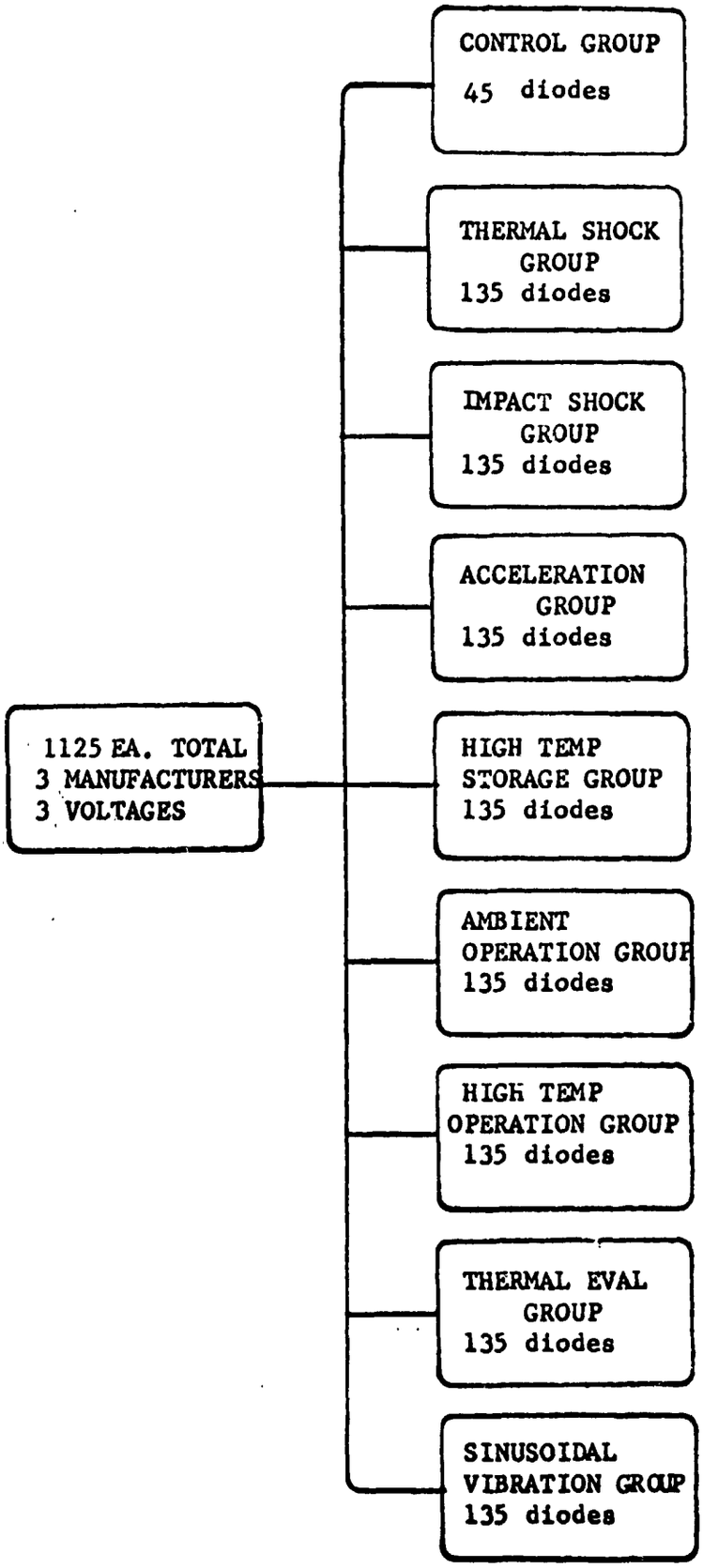
BASIC SCHEMATIC OF ZENER IMPEDANCE MEASUREMENT

TEST FLOW CHART PHASE I- STEP STRESS MATRIX EVALUATION

ATTACHMENT A

PHASE I
STEP STRESS EVALUATION
TEST FLOW DIAGRAM

WDL TP 1544-25
3 October 1966



S/N 0001 thru 0005, 0334 thru 0338, 0667 thru 0671, 1001 thru 1005, 1334 thru 1338, 1667 thru 1671, 2001 thru 2005, 2334 thru 2338, 2667 thru 2671.

S/N 0014 thru 0028, 0347 thru 0361, 0680 thru 0694, 1014 thru 1028, 1347 thru 1361, 1680 thru 1694, 2014 thru 2028, 2347 thru 2361, 2680 thru 2694.

S/N 0029 thru 0043, 0362 thru 0376, 0695 thru 0709, 1029 thru 1043, 1362 thru 1376, 1695 thru 1709, 2029 thru 2043, 2362 thru 2376, 2695 thru 2709.

S/N 0044 thru 0058, 0377 thru 0391, 0710 thru 0724, 1044 thru 1058, 1377 thru 1391, 1710 thru 1724, 2044 thru 2058, 2377 thru 2391, 2710 thru 2724.

S/N 0059 thru 0073, 0392 thru 0406, 0725 thru 0739, 1059 thru 1073, 1392 thru 1406, 1725 thru 1739, 2059 thru 2073, 2392 thru 2406, 2725 thru 2739.

S/N 0074 thru 0088, 0407 thru 0421, 0740 thru 0754, 1074 thru 1088, 1407 thru 1421, 1740 thru 1754, 2074 thru 2088, 2407 thru 2421, 2740 thru 2754.

S/N 0089 thru 0103, 0422 thru 0436, 0755 thru 0769, 1089 thru 1103, 1422 thru 1436, 1755 thru 1769, 2089 thru 2103, 2422 thru 2436, 2755 thru 2769.

S/N 0104 thru 0118, 0437 thru 0451, 0770 thru 0784, 1104 thru 1118, 1437 thru 1451, 1770 thru 1784, 2104 thru 2118, 2437 thru 2451, 2770 thru 2784.

S/N 0119 thru 0133, 0452 thru 0466, 0785 thru 0799, 1119 thru 1133, 1452 thru 1466, 1785 thru 1799, 2119 thru 2133, 2452 thru 2466, 2785 thru 2799.

EXAMPLES OF DATA CARD AND DATA STATISTICS COMPUTER RETURNS

ATTACHMENT B

EXAMPLE ONLY -- COMPUTER RETURN OF DATA STATISTICS

PHILCO FORD SRS DIVISION TEST RESULTS PROJECT: NASA EVAL TEST NAS 8 20315 PAGE 0001

TYPE 1N746A REV D LOT 6623 CARD GROUP 1 TEST PROCEDURE 1544-25

TEST CONDITION CODES AND DESCRIPTIONS:

UNIT CODE	DESCRIPTION
0000 E1	GROUP E 0HR MEAS. HIGH TEMP OP LIFE S/N 0001-0038
0000 E3	GROUP E 670 HR MEAS. HIGH TEMP OR LIFE S/N 0001-0038

UNIT CODE	1 I_R MIC AMPS	2 V_F VOLTS	3 V_Z VOLTS	4 Z_Z OHMS	5 Z_{ZK} OHMS
0001 E1	0.012	0.971	9.250	178.7	2530
0001 E3	0.006	0.969	9.280	191.4	1110
E1-E3 CHG	-0.006	-0.002	+0.030	+012.7	-1420
% CHG	-50%	-<1%	+<1%	+7%	-56%
MEAN X:	+0.006	+0.970	+9.265	+184.1	+1820
STANDARD DEV. X:	+0.006	+0.970	+9.265	+184.1	+1820

INTERPRETER SPACING

DATE _____

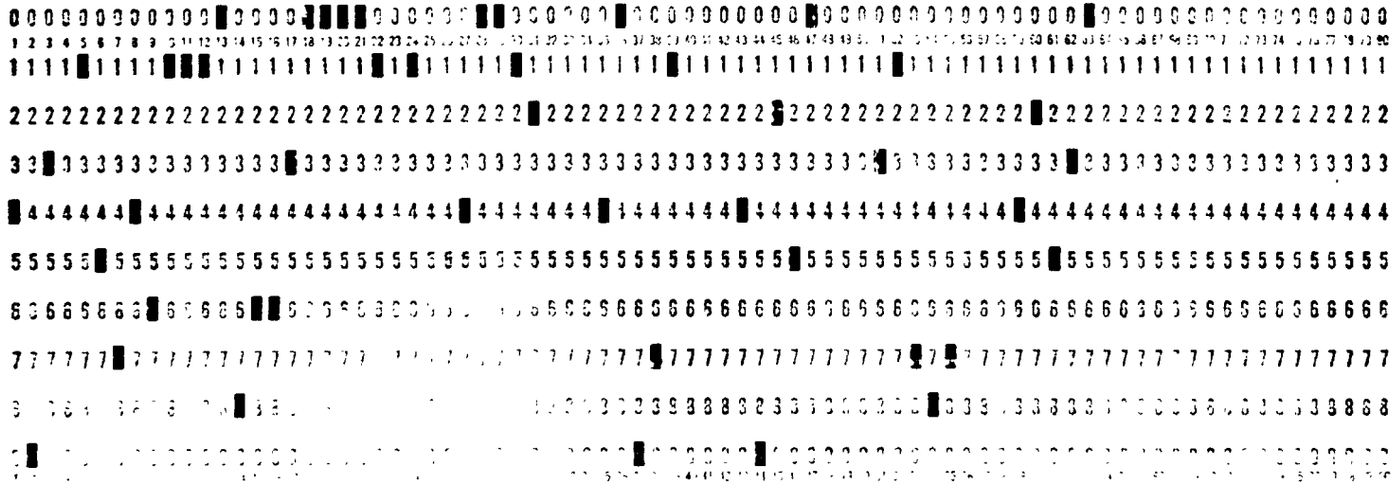
1.	CARD NAME	MFR NAME JEDEC NO.	DAY	MO.	YEAR	TEST NO.	SERIAL NO.	CARD NO.	DATA FIELD #2	DATA FIELD #3	DATA FIELD #4	DATA FIELD #5	DATA FIELD #6	DATA FIELD #7

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

MULTIPLIER — DATA

CURRENT MEASUREMENTS ARE RECORDED IN 10^{-12} AMP (PICOAMP)
VOLTAGE MEASUREMENTS ARE RECORDED IN 10^{-3} VOLT (MILLIVOLT)
IMPEDANCE MEASUREMENTS ARE RECORDED IN 10^{-3} OHM (MILLIOHM)
DECIMAL IS LOCATED BETWEEN 3RD & 4TH DIGIT OF DATA

IR	VF	VZ	ZZ	ZZK
.012 μA	.971 V	9.25 V	128 Ω	2530 Ω



EXAMPLE OF DATA CARD FORMAT

1544-25 ZENER DIODE RELIABILITY STUDY

JOB NO JOB NAME